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PHASE 2 ADAPTIVE MANAGEMENT TECHNICAL MEMORANDUM

Sanitary Sewer Overflow Consent Decree
Civil Action No. JFM-02-1524

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1 ADAPTIVE MANAGEMENT

1.1 Background

On September 30, 2002, the City of Baltimore (the "City") entered into a Consent Decree in the matter captioned *United States of America, et. al. v. Mayor and City Council of Baltimore, Maryland*, JFM02-CV1524 (D. Maryland) (the "Consent Decree") with the United States Environmental Protection Agency ("EPA"), the State of Maryland Department of the Environment ("MDE") and the United States Department of Justice ("DOJ"). As part of the Consent Decree ("CD") requirements, the City submitted a series of "*Collection System Evaluation and Sewershed Plans*" for each of the eight sewersheds located within the City of Baltimore. These sewershed plans were revised by the City in the December 2012 "*Sewershed Study and Plan Amendment"* report (the "Sewershed Amendment").

The Sewershed Amendment presented the results of continuous simulation hydraulic modeling for the City's collection systems tributary to the Back River Wastewater Treatment Plant ("WWTP") and the Patapsco WWTP. The recommended improvements to reduce capacity related sanitary sewer overflows ("SSOs") were based on a Hybrid Level of Protection ("LOP") that would be implemented through a phased, adaptive management approach.

During a January 31, 2013, meeting with the City, EPA and MDE, it was agreed that the City would submit a technical memorandum ("TM") detailing the proposed projects and time frames for the first phase of the adaptive management approach. This *Phase 1 Adaptive Management TM*, was submitted February 28, 2013. In a March 12, 2013, letter, EPA requested more information on the Phase 2 projects by July 1, 2013. This TM presents the requested Phase 2 project information.

1.2 Recommendations

As indicated in previous reports and TMs, the City proposes to use an adaptive management approach to implement Hybrid LOP improvements that include a baseline 5-year LOP and sensitive area conveyance improvements sized at a 10-year LOP. This two-phase adaptive management approach provides a structured, iterative process of decision making for acquiring actual data (e.g., infiltration/inflow ("I/I") reduction amounts from post-rehabilitation flow monitoring) prior to making decisions on future phased projects' sizing and design (e.g., required plant storage volumes). The Phase 1 improvement projects were previously summarized in the *Phase 1 Adaptive Management TM.* The Phase 2 improvement projects, as currently defined, are summarized below.

The data resulting from the various Phase 1 projects will be utilized to refine and potentially resize the City's Phase 2 projects. However, based on initial planning data and analysis results available at this time, the Phase 2 projects are expected to include the following:

- Additional conveyance system upgrades
- Potential conveyance system upgrades that may be required to convey Baltimore County flows (to be determined after design flows are received from Baltimore County and approved under the terms of their Consent Decree and refined as the post-construction flow monitoring data becomes available from the County)

- Additional meter basin rehabilitation as needed
- Additional flow storage or high-rate wet weather treatment facilities at the Back River WWTP as required. As part of Phase 1, 36 million gallons of storage will be constructed at the Back River WWTP.

A summary of the Phase 2 projects, as currently envisioned, is provided by sewershed in Section 2. Based on additional information that will be collected during the implementation of Phase 1 projects, using an adaptive management approach, the Phase 2 projects specified in Section 2 may be subject to change. The goal of achieving the Hybrid LOP remains unchanged.

The proposed order of project implementation would be to first construct the comprehensive sewer and manhole rehabilitation projects, followed by the conveyance system upgrades and any required additional storage and/or treatment capacity at the Back River WWTP. The conveyance system projects would be constructed in a downstream to upstream fashion to minimize negative hydraulic impacts on downstream reaches of the system.

The City will work closely with Baltimore County to obtain post-construction flow data and will coordinate the construction of new facilities required to convey both County and City flows to the WWTPs to avoid causing any downstream hydraulic problems.

2 PHASE 2 PROJECTS BY SEWERSHED

2.1 Comprehensive Sewer and Manhole Rehabilitation

The comprehensive sewer and manhole rehabilitation projects planned for implementation during Phase 2, along with the estimated costs are presented in **Table 2.1**. The primary rehabilitation method for the sewers is cured-in-place pipe (CIPP) lining, and the manholes will be lined with an epoxy coating. Other rehabilitation technologies will be considered as appropriate.

Table 2.1 Phase 2 Hybrid LOP- Comprehensive Sewer and Manhole Rehabilitation

Sewershed	Number of Basins Rehabilitated	Length of Sewers Rehabilitated (miles)	Number of Manholes Rehabilitated	Estimated Cost (million $)
Jones Falls	21	60.9	2,053	51.77
Herring Run	22	89.4	2,279	49.41
High Level	6	31.1	897	20.06
Low Level	22	92.0	2,650	68.31
Gwynns Falls	6	20.1	738	16.06
Total	**77**	**293.5**	**8,617**	**205.61**

All projects necessary to provide the Hybrid LOP in the Dundalk and Patapsco Sewersheds will be constructed during Phase 1. No sewer or manhole rehabilitation is required for the Hybrid LOP in the Outfall Sewershed.

Upon completion of the rehabilitation activities in each basin, post-construction flow monitoring will be initiated to quantify the efficacy of these projects and refine previous assumptions, if necessary, as outlined in the adaptive management approach. Subsequent conveyance system upgrade refinements and the need for additional storage and/or treatment capacity would be determined based on post-construction flows obtained by both the City and the County.

2.2 Conveyance System Upgrades

The Sewershed Amendment specified the quantities, diameters and locations of the conveyance system upgrades required to achieve the Hybrid LOP in Appendices B and C, based on the most current future flow assumptions. The Phase 2 portion of those conveyance system improvements are presented in **Table 2.2**.

Table 2.2 Phase 2 Hybrid LOP- Conveyance System Upgrades

Sewershed	Length of New Sewers[1] (lf)	Length of New Sewers[1] (miles)	Estimated Cost (million $)
Jones Falls	51,552	9.8	13.24
Herring Run	68,342	12.9	57.13
High Level	58,478	11.1	72.18
Low Level	46,651	8.8	39.54
Outfall	23,852	4.5	29.27
Gwynns Falls	130,245	24.7	145.41
Total	**379,120**	**71.8**	**356.77**

[1] Quantities include 46,269 linear feet (8.8 miles) of 4- and 6-inch public sewers that are recommended to be upsized to 8-inch, per the City's specification of minimum public sewer size. These sewers were not included in the Sewershed Amendment quantities, but are included in Table 2.2.

The Hybrid LOP conveyance system upgrades also include a capacity upgrade of the Quad Avenue Pumping Station, with an estimated cost of $2.71 million.

Conveyance system upgrades in the Patapsco Sewershed are scheduled to be completed during Phase 1. In the Hybrid LOP recommendations, no conveyance system upgrades are required in the Dundalk Sewershed.

2.3 Wet Weather Flow Storage and Treatment Capacity at Back River WWTP

The Back River Headworks Modifications and Flow Equalization Project, to be constructed during Phase 1, will provide a 36 million gallon storage facility. Upon completion of this project, the performance of this facility will be monitored, as well as the quality of the effluent discharged from the Back River WWTP. In addition, flows throughout the City and County collection systems will be monitored, as well as into the Back River WWTP, which will facilitate the refinement of the modeled I/I response, as necessary. Based on the observed data and refined hydraulic model, continuous simulations will be performed to ensure that the Hybrid LOP is

provided in the collection system, while meeting the effluent quality criteria in the plant's NPDES permit.

Any deficiencies at the Back River WWTP (hydraulic and/or NPDES permit-related) will be reconciled by providing additional storage, or a high-rate wet weather treatment facility that will be demonstrated to meet the plant effluent quality requirements.

3 CONCLUSIONS

Throughout Phase 1 of the adaptive management process, the City will be gathering data and monitoring performance to inform decision-making to adapt and refine the Phase 2 projects as needed.

Under the adaptive management approach, the Phase 2 projects are expected to change based on the observed efficacy of the Phase 1 projects which are designed to reduce I/I entering the collection system. The ultimate goal of achieving the Hybrid LOP remains.

The general order of Phase 2 project sequencing would begin with rehabilitating the remaining 77 basins (with post-construction flow monitoring commencing immediately upon completion), followed by constructing the conveyance system upgrades in a downstream to upstream fashion. The need for additional storage and/or treatment capacity will also be evaluated and implemented, if needed.

The total cost to implement all of the Phase 2 projects prior to the application of the adaptive management process, is estimated as $565.09 million. This total estimated cost of Phase 2 projects does not include post-construction flow monitoring.